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Design Andfabrication of Low Cost 3D Printer

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ABSTRACT

3D printing, is also known as additive manufacturing (AM), refers to various processes used to synthesize a 3dimension components. In 3D printing, successive layers of material are formed under computer control to create a 3D model of any shape or geometry is produced by a 3D printer. A 3D printer is a type of industrial robot. Futurologists such as Jeremy Rifkin believed that 3D printing signals the beginning of a 3rd industrial revolution, succeeding the production line assembly that dominated manufacturing starting in the late 19th century. Using the power of the Internet, it may eventually be possible to send a blueprint of any product to any place in the world to be replaced by 3D printing with “elemental inks” capable of being combined into any material substance of any desired form. This research paper is design and fabrication of low cost automation 3D printer and build components. And also assembly and integration of system interface to build a low cost automated working model of 3D printer.
Keywords: 3D Printer, Additive Manufacturing, Assembly and Integration.

I. INTRODUCTION

This paper gives design and fabrication of 3D printer, today 3D printer are widely used in industry for ready to manufacture within a short period of time and ready to market the product. This cutting edge technology is widely used in different manufacturing sectors. The 3d objects of any shape is build the 3D printer by the transferring the data electronically to the 3D printer from the 3d model which is build by using the modelling software and sent to the 3D printer. The model is build layer by layer and the final product is built on the 3D printer. 3D products are printed and the product is ready to communicate the ideas and market the product visually and decrease the time of production and ready to market.

The fabrication and assembly of a 3D printer is done by various components of the 3D printer like, screws, stepper motors, plywood, extruder etc., The assembled 3D printer is shown in the figure. The material used is PLA Poly Lactic Acid is used to build the 3D models built by the 3D printer by moving the axes. The 3D model created in the modelling software and exported to the printer where the 3D model is build layer by layer and the final product is built. The main objective of this research paper to design and fabricate a low cost automation 3D Printer and build the 3D models of any shape or geometry.

Figure 1. Assembled 3D printer

II. METHODS AND MATERIAL

Fabrication and Assembly of 3D Printer

The fabrication and assembly of 3D printer took us a couple of weeks because everything had to be done manually. Every dimension, shaft leveling, drilling of holes etc. was done manually. So whenever a part of specific dimension was required we either had to order it or had to get it done by the manufacturer individually.

Starting off with the items required for the fabrication, the list of all the items that will be used during the assembly/fabrication of 3D printer is mentioned in the tabulated format, it includes the number of components required and its specifications as per the prototype which has been planned.

Table 1

S. NO.	Name of component	Number of components	Specifications
1	Stainless steel rods	8	40mm length, 8mm Dia.
2	Upper nylon block	4	6x4x3 mm
3	Lower nylon block	8	4x3x3 mm
4	Pulley	8	8 mm Dia
5	Roller bearings	4	23mm OT Dia; 8mm IN Dia
6	Linear bearings	12	16mm OT Dia; 8mm IN Dia
7	Timing belt	4	5m
8	Stepper motor	4	Torque- 13.7 N.cm Steps- 200 Shaft Dia- 5mm Rating- 3-5 V;1-15 A
9	Extruder	1	MK8
10	Base plate	1	40x55mm
11	Nut and bolt	35	4 inch
12	Wooden box	1	58cmx48cmx73cm
13	Lead screw	2	8mm Dia; 40mm length
14	U-clamp	4	

Experimental Process

FDM begins with a software process, which processes an STL file (stereolithography file format), mathematically slicing and orienting the model for the build process. If required, support structures may be generated. The machine may dispense multiple materials to achieve different goals we may use one material to build up the model and use another as a soluble support structure or one could use multiple colors of the same type of thermoplastic on the same model.

The model or part is produced by extruding small flattened strings of molten material to form layers as the material hardens immediately after extrusion from the nozzle.

A plastic filament PLA or metal wire is unwound from a coil and supplies material to an extrusion nozzle which can turn the flow on and off. There is typically a worm-drive that pushes the filament into the nozzle at a controlled rate. The nozzle is heated to melt the material. The thermoplastics are heated past their glass transition temperature and are then deposited by an extrusion head.

The nozzle can be moved in both horizontal and vertical directions by a numerically controlled mechanism. The nozzle follows a tool-path controlled by a computer-aided manufacturing (CAM) software package, and the part is built from the bottom up, one layer at a time. Stepper motors or servo motors are typically employed to move the extrusion head. The mechanism used is often an X-Y-Z rectilinear design, although other mechanical designs such as deltabot have been employed.

Myriad materials are available, such as Acrylonitrile Butadiene Styrene ABS, Polylactic acid PLA, Polycarbonate PC, Polyamide PA, Polystyrene PS, lignin, rubber, among many others, with different trade-offs between strength and temperature properties. In addition, even the color of a given thermoplastic material may affect the strength of the printed object. printing parts from the filament material using FDM-technology.

Although as a printing technology FDM is very flexible, and it is capable of dealing with small overhangs by the support from lower layers, FDM generally has some restrictions on the slope of the overhang, and cannot produce unsupported stalactites.

During FDM, the hot molten polymer of PLA is exposed to air. Operating the FDM process within an inert gas atmosphere such as nitrogen or argon can significantly increase the layer adhesion and leads to improved mechanical properties of the 3D printed objects. An inert gas is routinely used to prevent oxidation during selective laser sintering.

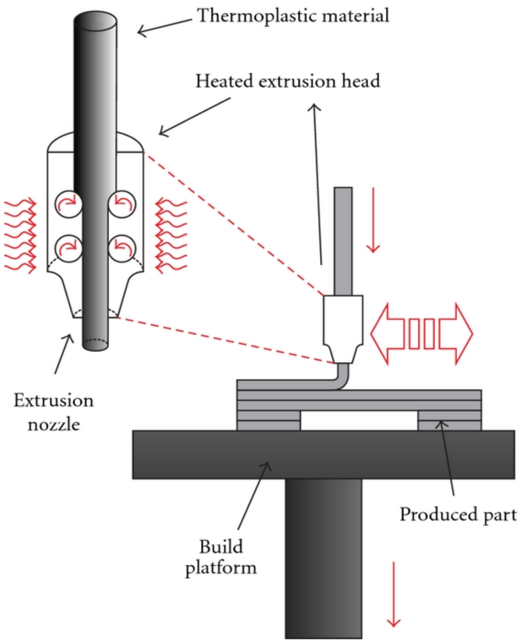

Figure 2. FDM Process

III. RESULTS AND DISCUSSION

3D models were built on the 3D printer. Finally we move towards our end product, after a few unsuccessful run and few minor adjustments, we successfully arrived at many different outcomes. The surface finish was considerably good, it is hard, the product is able to suustain many drops; showing it is strong enough for daily use. Let us now see some of the final products.

Figure 2. Batman Logo

Figure 4. A Waffer Block

There are small defects as the whole setup was hand bluit, though the fact that cannot be ignored is that for a hand built prototype this type of final product and surface finish is pretty much acceptable.

IV. CONCLUSION

- ✓ Low cost automation 3D printer is built to build the 3D models within a short span of time and ready to manufacture of 3D model of any shape without any jigs and fixtures.
- ✓ Fast product design modifications can be easily implemented.
- ✓ Implementation of new ideas.
- ✓ Product visualisation and communication to the customer is easier and understandable.

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